Is the altitudinal distribution of the Broad-toothed rat in Tasmania a result of the effects of Bennett's Wallaby?

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ABSTRACT

The Broad-toothed Rat *Mastacomys fuscus* is infrequently recorded in Tasmania and was only recently discovered at altitudes >1000 m, although the species occurs on the Australian mainland at >2200 m. A survey of Tasmanian alpine habitat found evidence of *M. fuscus* within a metre or two of the summit of Cradle Mountain at 1545 m, the highest altitude recorded for *M. fuscus* within Tasmania. There was a negative relationship between the presence of Bennett's Wallaby (*Macropus rufogriseus*) and *M. fuscus* at all sites. This is analogous to the absence of tall alpine herbfield as a plant community in Tasmania as a result of grazing by *M. rufogriseus*. At Cradle Mountain, *M. fuscus* occurred in alpine areas above rock barriers that prevented access by *M. rufogriseus* and hence allowed sufficient growth of grass to support populations of *M. fuscus*. This study further demonstrates the importance of *M. rufogriseus* in alpine ecosystems that lack a seasonal snow cover and raises the question of the potential impacts of *M. rufogriseus* in habitats with declining snow cover in mainland alpine areas.

Key words: climate change, marsupial lawn

Introduction

On the Australian mainland, the distribution of the Broad-toothed Rat *Mastacomys fuscus* ranges from sea level to >2200 m elevation (Green and Osborne 2003), and is climatically characterised by high rainfall and low temperatures. It inhabits areas with a moderate to dense ground cover of grasses or sedges with shrubs usually present, particularly along valley floors near to streams as well as wet sclerophyll forest and wet forest (Happold 1983). However, at alpine altitudes, the most common habitat is in rock outcrops and boulder fields immediately adjacent to grassy sites (Green and Osborne 2003). Until 2002, *M. fuscus* in Tasmania had a recorded distribution mainly in buttongrass moorland from sea level to 1000 metres (Driessen 2002; Hocking and Driessen 2000). A study by Driessen (2002) increased its known altitudinal range to 1340 m in alpine heathland at the Walls of Jerusalem (Fig. 1).

In Tasmania, the known distribution of *M. fuscus* is based on relatively few sites (Green *et al.* 2008) and it may be more common than was previously thought (Driessen 2002). The Swamp Rat (*Rattus lutreolus*) and *M. fuscus* are largely sympatric and confusion between the two may play a part in the failure to detect *M. fuscus* (Driessen 2002). A further suggestion that trap shyness may play a part (Hocking and Driessen 2000; Driessen 2002) is not born out by evidence on the mainland (Green 2002). However, it does appear to be true that *M. fuscus* occurs at low densities in Tasmania compared with mainland populations of up to 19 per ha (mean 12.1) in N.S.W. (Happold 1998) and 20 per ha in Victoria (Wallis *et al.* 1982). For example, in Tasmania, Green (1968) recorded 5 individual *M. fuscus* (and 13 *R. lutreolus*) in approximately 1 ha of montane buttongrass moorland over a 13 month period. This contrasts with the Snowy Mountains on the Australian mainland where, on 1.7 ha, the author (unpublished) recorded a minimum 91 rodents in less than 12 months including 54 individual *M. fuscus*.

A BIOCLIM analysis of the distribution of *M. fuscus* in Tasmania under a scenario of climate warming suggested a contraction from coastal and inland lowland areas into mountains with the only really suitable areas being in the vicinity of Cradle Mountain-Lake St. Clair (Green *et al.* 2008). However, despite suitable climate, the species has not previously been reported from altitudes higher than 1000 metres in that region. The present study examines a survey of summits looking for evidence of *M. fuscus* and seeks to explain its distribution.

Methods

The projected current distribution of *M. fuscus* within Tasmania, modelled using BIOCLIM (Fig. 1; Green *et al.* 2008), included areas climatically suitable but apparently unoccupied, based on trapping data from Mt. Field in 1985 (Green 1988) and general surveys searching for small mammal runways, burrows, scats and other evidence in most Tasmanian alpine areas including Mt. Field and Ben Lomond from 1988-1993 (K. Green unpubl. data). During December 2009, three alpine areas in Tasmania were visited. At all areas visited, the most suitable habitat for *M. fuscus* was located; at high altitudes on the mainland *M. fuscus* has been found in six broad habitat types (see Green and Osborne 2003). Within the sites, searches were made for scats (following

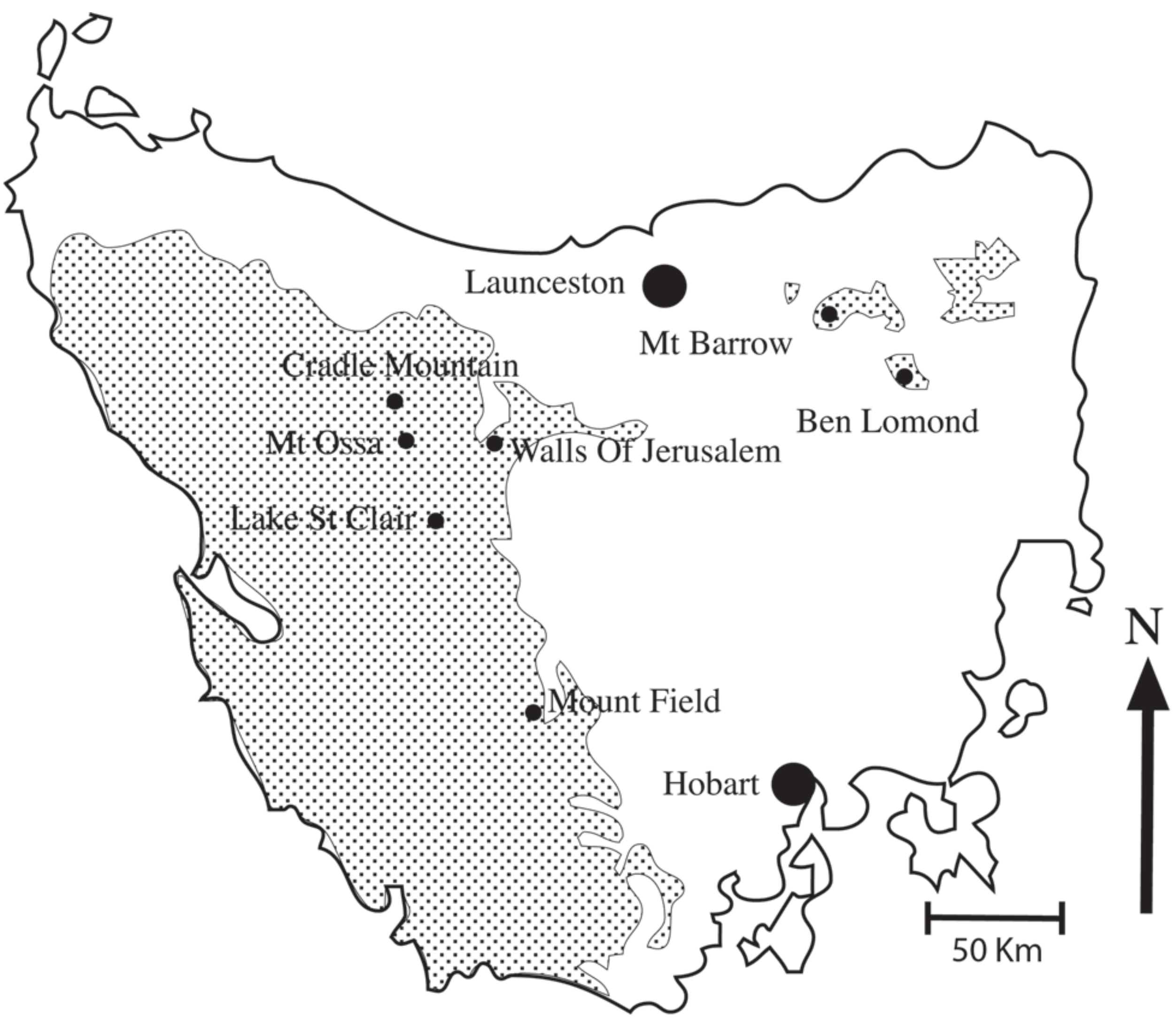

Figure 1. BIOCLIM-based predicted Tasmanian distribution of *Mastacomys fuscus* in Tasmania under the current climate together with locations mentioned in the text. Figure modified from Green *et al.* (2008).

Happold 1989 and Wallis 1992) to determine whether the habitat had been used by *M. fuscus* in the recent past. Scats of *M. fuscus* are easily distinguished from those of sympatric species such as *R. lutreolus* that are coarse, with a granulated surface often red-brown in colour (Triggs 1984). Scats of *M. fuscus* are fibrous, green when fresh, paling to straw-coloured with time, and contain small fragments of undigested grass cuticle and fibre (Happold 1989). An individual produces 200-400 scats per day, which may last for up to five years, so that a search for scats is a quick method of determining usage of the habitat by *M. fuscus* (Happold 1989). For example, in a study of the distribution of *M. fuscus* in NSW, 79% of sites were found within the first minute, with two-thirds of these within five seconds. Only 2% of sites were found after five minutes had elapsed (Green and Osborne 2003). At all sites, other evidence of *M. fuscus* such as hay piles (see Green and Osborne 1994), and scats of other herbivores particularly Bennett's Wallaby (*Macropus rufogriseus*), were also searched for. Search time varied among sites depending upon openness but was generally a minimum of five minutes or until scats were found.

Results and Discussion

Droppings of *M. fuscus* were not found at Mt. Field, Mt. Barrow and the alpine plateau below Cradle Mountain, all sites otherwise apparently suitable but where droppings of *M. rufogriseus* were present. However, on the Cradle Mountain massif, droppings of *M. fuscus* and hay piles were common within one to two metres of the summit of Cradle Mountain itself (1545 m) and on the SE side of Smithies Peak (1525 m), both sites where droppings of *M. rufogriseus* were absent. This new Tasmanian altitudinal record is at a height just 70 m short of that of Tasmania's highest mountain, Mt. Ossa.

The two occupied sites on Cradle Mountain had bedrock and boulders as major structural units, with grass, probably *Poa gunnii* (J. Whinam pers. comm. 2010) present where soil had accumulated. Similar habitats were found on Mt. Field and Mt. Barrow but had no evidence of *M. fuscus*. However, rock outcrops and boulder fields immediately adjacent to grassy sites constituted 25% of all 196 sites where *M. fuscus* was recorded in the Snowy Mountains (Green and Osborne 2003). The diet of *M. fuscus* in the Snowy Mountains consists mainly of grasses, contributing between 52% and 87% to the diet through the year (Carron *et al.* 1990). In areas where food was not limiting, the presence of M. *fuscus* was found to be promoted by structural features (Carron *et al.* 1990) of which boulders played a major part (Green and Osborne 2003). The converse of this is, being herbivorous and feeding mainly on sedges and grasses, a dense ground layer of these plants is important and their lack limits penetration of M. *fuscus* into forests (Menkhorst 1995) and possibly into most Tasmanian alpine heaths. *Macropus rufogriseus,* whose food is also composed mainly of grasses, may be present at alpine elevations in Tasmania at any time throughout winter owing to the lack of persistent snow cover and is more commonly seen there than at alpine elevations on the mainland (Green and Osborne 1994).

The reason for the absence of M. *fuscus* from many climatically suitable areas of Tasmania may be the same as for the absence of herbfields. In its place is a very short sward, known locally as 'marsupial lawn'. Tall alpine herbfield is one of the most widespread vegetation communities in the alpine areas of mainland Australia. However, although many of the herbfield species occur in Tasmania, the tall alpine herbfield community is largely absent, a fact that Bridle and Kirkpatrick (1998) attributed to preferential grazing of the constituent species by M. *rufogriseus*. In the Snowy Mountains, Green and Osborne (2003) found declining evidence of M. *fuscus* at lower, peripheral sites owing in part to the presence of larger herbivores that removed or damaged the protective vegetative cover.

Just as Bridle and Kirkpatrick (1998) found tall herbs and grass growing on islands in the Ouse River system in the east Central Plateau of Tasmania where they were protected from M. *rufogriseus*, the present study found tall grass and M. *fuscus* on summits that were protected from M. *rufogriseus* by large boulders. Although M. *rufogriseus* is capable of 'surprising agility' on rock (Green 1973) the boulders girdling Cradle Mountain are probably beyond their ability. As such, the grass near the summits of Cradle Mountain is undisturbed by large grazing animals and, with sufficient cover provided by the boulders, M. *fuscus* is able to flourish. It is likely that there are other mountain-top populations in Tasmania protected by the same mechanism. Previously the highest recorded occurrence of M. *fuscus* in the Cradle Mountain area was at 1000 m (Driessen 2002). The present observation is more than 500 m upslope but with no known records nor evidence in between where non-heath communities are mainly 'marsupial lawn'. If M. *fuscus* does not occur throughout these middle altitudes (1000-1500 m) thus forming connections with low altitude populations, these mountain-top populations may be genetically isolated. These may be populations that have been isolated ever since seasonal snow cover or some other conditions excluded M. *rufogriseus* from middle altitudes or at least reduced their numbers at some time in the past and allowed the colonization of these peaks by M. *fuscus.* The other area above 1000 m where M. *fuscus* has been found, the Walls of Jerusalem, also had 10-15 cm tall *P. gunnii* beneath a 75-85% cover of predominantly prickly *Richea* heath 50-100 cm tall (Driessen 2002). The site also had M. *rufogriseus* present (M. Driessen pers. comm. 2010) and in open grasslands, where no evidence of M. *fuscus* was found, the grass *P. gunnii* was < 5 cm tall. This suggests that dense *Richea* heath might provide protection for the grass from grazing pressure, thus allowing the two mammal species to co-exist.

The probable suppression of numbers of M. *fuscus* by the grazing habits of M. *rufogriseus* is of concern on the mainland where currently M. *rufogriseus* is excluded from higher altitudes by seasonal snow cover that will decline with future climate warming (Green and Pickering 2002).

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